AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (Previously presented) A low resistivity silicon electrode adapted to be mounted in a plasma reaction chamber used in semiconductor substrate processing, comprising:

a silicon electrode comprising a showerhead electrode having a plurality of gas outlets arranged to distribute process gas in the plasma reaction chamber during use of the showerhead electrode, the electrode having a thickness of about 0.3 inch to 0.5 inch and an electrical resistivity of less than 1 ohm-cm, the electrode having an RF driven or electrically grounded surface on one side thereof, the surface being exposed to plasma in the plasma reaction chamber during use of the electrode.

Claim 2 (Canceled)

3. (Previously presented) The electrode of Claim 1, wherein the gas outlets have diameters of 0.020 to 0.030 inch and the gas outlets are distributed across the exposed surface.

4. (Original) The electrode of Claim 1, wherein the electrode comprises single crystal silicon or silicon carbide having heavy metal contamination of less than 10 parts per million.

5. (Original) The electrode of Claim 1, wherein the electrode comprises an electrically grounded upper electrode of a parallel plate plasma reactor.

6. (Original) The electrode of Claim 1, wherein the electrical resistivity of the electrode is less than 0.1 ohm-cm.

7. (Original) The electrode of Claim 1, wherein the electrical resistivity of the electrode is less than 0.05 ohm-cm.

8. (Original) A plasma etch reactor having an electrode assembly which includes the electrode of Claim 1, the electrode being bonded to a support member by an elastomeric joint, the elastomeric joint comprising an electrically conductive elastomeric material between the electrode and the support member, the elastomeric material including an electrically conductive filler which provides an electrical current path between the electrode and the support member.

9. (Original) A plasma etch reactor having an electrode assembly which includes the electrode of Claim 1, the electrode being resiliently clamped to a support member by a clamping member.

10. (Previously presented) A plasma reaction chamber including the showerhead electrode of Claim 1, the showerhead electrode being bonded or clamped to a temperature-controlled member in an interior of the plasma reaction chamber, the temperature-controlled member including a gas passage supplying a process gas to the showerhead electrode, the temperature-controlled member including a cavity and at least one baffle plate located in the cavity, the gas passage supplying process gas so as to pass through the baffle prior to passing through the showerhead electrode.

Claims 11-20 (Canceled)

21. (Currently amended) ~~The electrode of Claim 1, further comprising a backing plate elastomer bonded to the electrode.~~ A low resistivity silicon electrode adapted to be mounted in a plasma reaction chamber used in semiconductor substrate processing, comprising:

a silicon electrode comprising a showerhead electrode having a plurality of gas outlets arranged to distribute process gas in the plasma reaction chamber during use of the showerhead electrode, the electrode having a thickness of about 0.3 inch to 0.5 inch and an electrical resistivity of less than 1 ohm-cm, the electrode having an RF driven or

electrically grounded surface on one side thereof, the surface being exposed to plasma in the plasma reaction chamber during use of the electrode; and

a backing plate elastomer bonded to the electrode.

Claim 22 (Canceled)

23. (Previously presented) The electrode of Claim 21, wherein the backing plate includes gas distribution holes communicating with the gas outlets in the electrode.

24. (Canceled)

25. (Previously presented) The electrode of Claim 21, wherein the backing plate is of aluminum, aluminum alloy, silicon carbide or graphite.

Claim 26 (Canceled)

27. (Previously presented) The electrode of Claim 1, wherein the gas outlets comprise ultrasonically drilled holes.

28. (Previously presented) The electrode of Claim 1, further comprising a support member bonded to the electrode.

29. (Previously presented) The electrode of Claim 28, wherein the support member comprises a plate, cylinder or projections on a base member.

30. (Currently amended) ~~The electrode of Claim 1, having a thickness of about 0.375 to 0.5 inch.~~ A low resistivity silicon electrode adapted to be mounted in a plasma reaction chamber used in semiconductor substrate processing, comprising:

a silicon electrode comprising a showerhead electrode having a plurality of gas outlets arranged to distribute process gas in the plasma reaction chamber during use of the showerhead electrode, the electrode having a thickness of about 0.375 inch to 0.5 inch and an electrical resistivity of less than 1 ohm-cm, the electrode having an RF driven or electrically grounded surface on one side thereof, the surface being exposed to plasma in the plasma reaction chamber during use of the electrode.

31. (New) The electrode of Claim 21, wherein the backing plate is elastomer bonded to the electrode by thin beads of elastomer between the backing plate and electrode.

REMARKS

By this Amendment, Claims 21 and 30 have been rewritten in independent form including the combinations of features of Claims 1 and 21, and Claims 1 and 30, respectively. New Claim 31 has been added. Claims 1, 3-10, 21, 23, 25 and 27-31 are pending. Reconsideration of the May 20, 2003 Official Action is respectfully requested.

1. Rejection Under 35 U.S.C. § 112, First Paragraph

Claims 1, 3-10, 21, 23, 25 and 27-29 stand rejected under 35 U.S.C. §112, first paragraph. The reasons for the rejection are stated at page 2 of the Official Action. The rejection is respectfully traversed.

Claim 1 recites the feature of "the electrode having a thickness of about 0.3 inch to 0.5 inch." The Official Action asserts that the specification fails to provide support for a silicon electrode having a thickness of about 0.3 inches to 0.5 inches. Applicants respectfully disagree with this assertion. Support for an electrode having such thickness is provided at page 13, lines 15-21 of the specification. The specification discloses that one approach for enhancing reduction of the center-to-edge temperature variation across the electrode is "by making the electrode *thicker than conventional electrodes*" (emphasis added). A "*conventional* 0.25 inch thick electrode" (emphasis added) is described at page 13, line 21 of the specification. Accordingly, the specification as a whole clearly discloses that the electrode can be made thicker than a conventional 0.25 inch thick electrode in order to enhance reduction of the center-to-edge temperature variation across the electrode. The specification further describes at page 13, lines 19-20, "*for example*, the electrode can have an increased thickness of 0.375 or even 0.50 inch compared to a *conventional* 0.25 inch

thick electrode." Accordingly, the specification provides a written description of an electrode having a thickness greater than a conventional 0.25 inch electrode, and also gives specific examples of a 0.375 inch and a 0.5 inch electrode thickness. Thus, Applicants are entitled to claim an electrode thickness in the range of greater than 0.25 inch to 0.5 inch.

The Official Action also asserts at page 16, first paragraph, that "the specification, as originally filed, fails to identify with 'detailed particularity' that the electrode thickness is being incorporated by reference from the Degner et al. reference (note from page 6, lines 26-29 of the instant application only specific mention of incorporating metallurgical or adhesive bonding of an electrode to a support from the Degner et al. reference) ...." Applicants respectfully disagree with this assertion for the following reasons.

Degner is described in the specification at page 1, lines 8-17, where it is explained that "*[e]lectrodes* used in plasma processing reactors for processing semiconductor substrates such as silicon wafers are disclosed in U.S. Patent Nos. 5,074,456 and 5,569,356, *the disclosures of which are hereby incorporated by reference*" (emphasis added). At page 6, lines 26-29, of the specification, it is explained that "alternatively, the electrode can be metallurgically or adhesively bonded to a support by any suitable technique such as that described in commonly owned U.S. Patent No. 5,074,456 to Degner et al., *the disclosure of which is hereby incorporated by reference*" (emphasis added). These statements identify with detailed particularity both the specific location of the incorporated material, i.e., in Degner, and the specific material incorporated, i.e., the *disclosure* of Degner. Applicants further submit that the *entire disclosure* of Degner has been incorporated by reference in the specification.

The issue of incorporation by reference was addressed by the Court of Appeals for the Federal Circuit in *Ultradent Products Inc. v. Life-Like Cosmetics Inc.*, 44 USPQ2d 1336 (Fed. Cir. 1997). In *Ultradent Products*, the court considered the scope of the disclosure of U.S. Patent No. 4,990,089 to Munro ("Munro") and, more particularly, what part of the entire contents of U.S. Patent No. 3,657,413 to Rosenthal ("Rosenthal") had been incorporated by reference in Munro's specification by the following statement in Munro:

> The commercial product PROXIGEL, described in U.S. Pat. No. 3,657,413 issued on Apr. 18, 1972 to M. W. Rosenthal, *which patent is hereby incorporated herein by reference* ...." (Emphasis added; col. 2, lines 10-15.)

The Federal Circuit concluded that:

> The Munro patent incorporates by reference *the entire contents of the Rosenthal disclosure*. Ultradent's assertion that Munro 'says nothing' about the Rosenthal compositions and merely discloses using the commercial embodiment of the Rosenthal patent is contrary to the rules of practice, which permit incorporation of prior art by reference. (Emphasis added; citations omitted.)

Ultradent Products at 44 USPQ2d 1139.

That is, the Federal Circuit decided that the phrase "which patent is hereby incorporated by reference" has the effect of incorporating *the entire contents* of the patent in the referencing patent. The court refuted the argument that only the portion of the contents of the incorporated patent that is *specifically referred to* in the referencing patent is incorporated by reference therein.

The assertion in the Official Action that the entire disclosure of Degner has not been incorporated by reference in the specification also is in direct conflict with the patent

examining procedures set forth in MPEP §201.06(c), page 200-37 (Rev. 1, Feb. 2003), which states that a prior application may be incorporated by reference into another application by including in the referencing application "a statement that such specifically enumerated prior application or applications are 'hereby incorporated herein by reference'." The statements in the specification that "the disclosure of which is hereby incorporated by reference" are substantially equivalent to the statement recommended in MPEP §201.06(c). Thus, it is submitted that the statements in the specification are effective to incorporate the *entire contents* of Degner in the specification.

Applicants respectfully submit that the cases of *Advanced Display Systems Inc. v. Kent State University*, 54 USPQ2d 1673 (Fed. Cir. 2000); *In re Seversky*, 177 USPQ 144, 146 (CCPA 1973); and *In re Sanders*, 170 USPQ 213 (CCPA 1971) cited in the Official Action do not support the rejection.

For reasons stated above, the description at page 13, lines 15-21, of the specification fully supports the recited feature of "the electrode having a thickness of about 0.3 inch to 0.5 inch" in Claim 1. Accordingly, no "essential material" regarding the electrode thickness is incorporated in the specification from Degner. Furthermore, Degner has been properly incorporated by reference in the present application. Therefore, withdrawal of the rejection is respectfully requested.

2. Rejection of Claims 1, 4-10, 21, 23, 25, and 27-30 Under 35 U.S.C. §103

Claims 1, 4-10, 21, 23, 25, and 27-30 stand rejected under 35 U.S.C. §103(a) over Degner in view of JP 2-20018 ("Murai"). The reasons for the rejection are stated at pages 3-5 of the Official Action. The rejection is respectfully traversed.

Claim 1 recites a low resistivity silicon electrode, which comprises "a silicon electrode comprising a showerhead electrode having a plurality of gas outlets arranged to distribute process gas in the plasma reaction chamber during use of the showerhead electrode, *the electrode having a thickness of about 0.3 inch to 0.5 inch and an electrical resistivity of less than 1 ohm-cm*, ... the surface being exposed to plasma in the plasma reaction chamber during use of the electrode" (emphasis added).

The Official Action acknowledges that Degner does not disclose or suggest that the electrode 12 is a single crystal silicon electrode having an electrical resistivity of less than 0.05 ohm-cm, as recited in Claim 1. However, it is alleged that Murai discloses a single crystal silicon electrode having an electrical resistivity of less than 0.05 ohm-cm, and that it would have been obvious to modify Degner's apparatus to include an electrode having an electrical resistivity of less than 0.05 ohm-cm. Applicants respectfully disagree with these assertions.

Murai also does not disclose or suggest an electrode thickness of about 0.3 inch to 0.5 inch. In fact, Murai is silent regarding the thickness of the electrode, and thus provides no suggestion to select the particular thickness of Degner's electrode plate of about 0.3 inch to 0.5 inch, and to modify Degner's electrode plate of that thickness to have an electrical resistivity of less than 1 ohm-cm, as recited in Claim 1.

As Saito fails to provide the required suggestion or motivation to modify Degner, the Official Action has not established a *prima facie* case of obviousness regarding the low resistivity, silicon electrode recited in Claim 1. *See* MPEP §2143.

3. The Claimed Subject Matter Provides Unexpected Superiority Over the Prior Art

The attached Declaration Under 37 C.F.R. §1.132 by Jerome S. Hubacek, one of the inventors of the claimed subject matter, explains the unexpected superiority of the claimed subject matter as compared to the prior art. More particularly, the Rule 132 Declaration explains that the claimed low resistivity, silicon electrode provides (a) a reduced center-to-edge temperature gradient; (b) an increased lifetime; (c) reduced byproduct deposition behind the electrode; and (d) reduced electrical resistance.

The Rule 132 Declaration should be considered by the Patent Office consistent with the following principles. First, the claimed invention must be compared to the closest prior art. *See, In re Baxter*, 21 USPQ2d 1281, 1285 (Fed. Cir. 1991), and MPEP §716.02(e). It is improper to require Applicants to compare claimed subject matter with subject matter resulting from a combination of references applied under 35 U.S.C. §103, as this "would be requiring comparison of the results of the invention with the results of the invention." *See, In re Chapman*, 148 USPQ 711, 714, (CCPA 1966), and MPEP §716.02(f).

Second, "evidence and arguments directed to advantages not disclosed in the specification cannot be disregarded." *See*, MPEP §716.02(f).

a. Reduction of Center-to-Edge Temperature Gradient of Electrode

As explained in the Rule 132 Declaration, low resistivity, single crystal silicon showerhead electrodes were tested in a plasma reaction chamber. The showerhead electrodes included a plurality of gas outlets with a diameter of 0.025 inch arranged to distribute a process gas in the reaction chamber during use of the electrodes. The

showerhead electrodes had thicknesses of 0.15 inch, 0.18 inch, 0.25 inch, and 0.35 inch, and were bonded to a graphite support member by an elastomeric joint.

Power levels of 1000 watts, 2000 watts, and 3000 watts were applied to each of the showerhead electrodes, and additionally a power level of 4000 watts was applied to the showerhead electrodes having a thickness of 0.25 inch and 0.35 inch. The center-to-edge temperature gradients of the showerhead electrodes having a thickness of 0.15 inch, 0.18 inch, and 0.35 inch were modeled based on temperature measurements made for the 0.25 inch thick electrode.

The comparative test data are plotted in the graph in Appendix A attached to the Rule 132 Declaration. The graph shows that *at each applied power level*, the center-to-edge temperature gradient decreased as the showerhead electrode thickness increased. For example, at a power level of 3000 watts, increasing the electrode thickness from 0.25 inch (which falls outside the electrode thickness range of 0.3 to 0.5 inch recited in Claim 1) to 0.30 inch reduces the center-to-edge temperature gradient by about 15% (based on the centigrade temperature scale), and increasing the electrode thickness from 0.25 inch to 0.35 inch reduces the center-to-edge temperature gradient by about 35%. This result is described at page 13, lines 15-19, of the specification. Reducing the temperature gradient surprisingly reduces the probability of cracking of the electrode, especially at high power levels, such as 4000 watts.

b. Improvement of Showerhead Electrode Lifetime

The Rule 132 Declaration also explains that increasing the showerhead electrode thickness increases the lifetime of the electrode, i.e., the number of RF hours that the

electrode can be operated for without failing. The maximum amount of power that a showerhead electrode can be operated at without failing is dependent on its thickness. The relationship between showerhead electrode thickness and the power level applied to the electrode is plotted in the graph in Appendix B attached to the Rule 132 Declaration. The region above line A represents the experimentally determined operating range in which the probability of electrode cracking is low; the region below line A represents the operating range in which the probability of electrode cracking is high. Line A can be extrapolated to higher electrode thickness values to show that showerhead electrodes having a thickness of 0.30 inch or greater, e.g., 0.35 inch, 0.375 inch, or greater (which falls within the electrode thickness range of 0.3 to 0.5 inch recited in Claim 1) can be operated at significantly higher power levels than electrodes having a thickness of 0.25 inches or less, which thickness falls outside of the range recited in Claim 1. *See*, *In re Kollman*, 201 USPQ 193 (CCPA 1979).

c. Reduction of Byproduct Deposition Behind Electrode

The Rule 132 Declaration further explains that increasing the showerhead electrode thickness increases the length of the gas passages and also increases the pressure behind the electrode. *See* page 12, lines 26-30 of the specification. The showerhead electrode having a thickness of 0.35 inch reduces backstreaming, i.e., the deposition of particle defects behind the electrode, as compared to the electrodes having a thickness of 0.15 inch, 0.18 inch, and 0.25 inch, which fall outside of the thickness range recited in Claim 1.

d. Reduction of Electrical Resistance of Electrode

The Rule 132 Declaration also explains that increasing the thickness of the showerhead electrode decreases its electrical resistance. As a result, ohmic losses in the electrode are reduced, and coupling of radio frequency (RF) power to the plasma reactor is enhanced. Reducing the impedance path of the RF provides for a higher etch rate of substrates in the plasma reactor at a set power level applied to the electrode. Surprisingly, the etch uniformity was as good as, or better than, a lower resistance electrode, e.g., a thinner electrode. Also, reducing the electrode resistance improves plasma confinement in the plasma reactor. *See* page 5, lines 2-8, of the specification.

Applicants respectfully submit that the evidence and arguments provided in the Rule 132 Declaration are sufficient to rebut the alleged *prima facie* case of obviousness. Accordingly, it is respectfully submitted that the subject matter recited in Claim 1 is patentable over the combination of Degner and Murai.

Claims 4-10 and 27-30 depend from Claim 1 and thus are also patentable over the combination of Degner and Murai for at least the same reasons that Claim 1 is patentable.

Claim 21, as amended, recites the combination of features recited in Claim 1 and, in addition, recites the feature of "a backing plate elastomer bonded to the electrode." Claim 21 is also patentable over the combination of Degner and Murai for at least the same reasons that Claim 1 is patentable.

Withdrawal of the rejection is therefore respectfully requested.

4. **Rejection of Claim 3 Under 35 U.S.C. §103**

Claim 3 stands rejected under 35 U.S.C. §103(a) over Degner in view of Murai, and further in view of U.S. Patent No. 5,993,597 to Saito et al. ("Saito"). The reasons for the rejection are stated at page 5 of the Official Action. The rejection is respectfully traversed for the following reasons.

Claim 3 recites the feature of "the gas outlets have diameters of 0.020 to 0.030 inch and the gas outlets are distributed across the exposed surface." It is acknowledged in the Official Action that Degner and Murai fail to disclose the diameter of the gas outlets as recited in Claim 3. However, it is asserted that Saito cures the deficiencies of Degner and Murai. Applicants respectfully disagree.

Not only does Saito fail to disclose or suggest an electrode thickness of about 0.3 inch to 0.5 inch, Saito's electrode is thinner than a conventional 0.25 inch electrode. Thus, Saito teaches away from the combination of features recited in Claim 3, and thus provides no motivation to modify Degner's electrode to have the thickness recited in Claim 1. Therefore, dependent Claim 3 also is patentable over the combination of Degner, Murai and Saito for at least the same reasons that Claim 1 is patentable.

Withdrawal of the rejection is therefore respectfully requested.

5. **Rejection of Claims 1, 4-10, 21, 23, 25, and 27-30 Under 35 U.S.C. §103**

Claims 1, 4-10, 21, 23, 25, and 27-30 stand rejected under 35 U.S.C. §103(a) over Murai in view of Degner. The reasons for the rejection are stated at pages 5-8 of the Official Action. The rejection is respectfully traversed.

It is acknowledged in the Official Action that Murai fails to suggest an electrode having a thickness of about 0.3 to 0.5 inches, or that the silicon electrode is a showerhead. However, it is asserted that it would have been obvious to modify Murai's electrode in view of Degner to achieve the combination of features recited in Claim 1. Applicants respectfully disagree with these assertions.

In contrast to Murai, Degner discloses a *showerhead electrode assembly* 10 having a substantially different construction than Murai's apparatus. The asserted modification of Murai's apparatus would require substantial reconstruction and redesign of the apparatus and substantially change its principle of operation. For at least this reason, the applied references do not render the claimed subject matter *prima facie* obvious.

Furthermore, modifying Murai's silicon electrode by increasing its thickness would not achieve the claimed subject matter; rather, it would still result in a silicon electrode that is *not* a showerhead electrode. Moreover, such showerhead electrode would be unsuitable for Murai's apparatus because it is not designed to utilize such electrode.

Also, the unexpected results presented in the Rule 132 Declaration that are achieved by the subject matter recited in Claim 1 rebut any alleged *prima facie* case of obviousness over the combination of Degner and Murai. Accordingly, it is respectfully submitted that Claim 1 also is patentable over the combination of Murai and Degner. Therefore, withdrawal of the rejection is respectfully requested.

Dependent Claims 4-10, 23, 25, and 27-30, and independent Claim 21, also are patentable over the combination of Murai and Degner for at least the same reasons that Claim 1 is patentable.

Withdrawal of the rejection is therefore respectfully requested.

6. Rejection of Claim 3 Under 35 U.S.C. §103

Claim 3 stands rejected under 35 U.S.C. §103(a) over Murai in view of Degner, and further in view of Saito. The reasons for the rejection are stated at pages 8-9 of the Official Action. The rejection is respectfully traversed for the following reasons.

Saito also provides no motivation to modify Murai's electrode to achieve the combination of features recited in Claim 1, including an electrode thickness of about 0.3 inch to 0.5 inch. Therefore, dependent Claim 3 also is patentable over the combination of Murai, Degner and Saito for at least the same reasons that Claim 1 is patentable.

Withdrawal of the rejection is therefore respectfully requested.

7. Rejection of Claims 1, 3-10, 21, 23, 25, and 27-30 Under 35 U.S.C. §103

Claims 1, 3-10, 21, 23, 25, and 27-30 stand rejected under 35 U.S.C. §103(a) over Saito in view of Degner. The reasons for the rejection are stated at pages 9-12 of the Official Action. The rejection is respectfully traversed for the following reasons.

As acknowledged in the Official Action, Saito does not suggest an electrode having a thickness of about 0.3 to 0.5 inches. Degner fails to suggest modifying Saito to provide the silicon electrode recited in Claim 1. Thus, Claim 1 is patentable over the combination of Saito and Degner.

Dependent Claims 3-10, 23, 25, and 27-30, and independent Claim 21, also are patentable over the cited references for at least the same reasons that Claim 1 is patentable. Therefore, withdrawal of the rejection is respectfully requested.

8. Rejection of Claims 1, 3-10, 21, 23, 25, and 27-30 Under 35 U.S.C. §103

Claims 1, 3-10, 21, 23, 25 and 27-30 stand rejected under 35 U.S.C. § 103(a) over Degner in view of Saito. The reasons for the rejection are stated at pages 12-14 of the Official Action. The rejection is respectfully traversed for the following reasons.

Saito does not suggest modifying Degner's electrode plate to provide a silicon electrode having both an electrical resistivity and thickness as recited in Claim 1. Thus, Claim 1 is patentable over the combination of Degner and Saito.

Dependent Claims 3-10, 23, 25, and 27-30, and independent Claim 21, also are patentable over the cited references for at least the same reasons that Claim 1 is patentable. Therefore, withdrawal of the rejection is respectfully requested.

10. New Claim

New Claim 31 depends from Claim 21 and recites the feature of "the backing plate is elastomer bonded to the electrode by thin beads of elastomer between the backing plate and electrode." Support for this feature is provided at page 10, lines 25-29, of the specification. The silicon electrode recited in Claim 31 also is patentable for at least the same reasons that Claim 21 is patentable.

For the foregoing reasons, withdrawal of the rejections and prompt allowance of the Application are respectfully requested.

Respectfully submitted,

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Date: October 7, 2003